Paper ID: 52494
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IAF SPACE EDUCATION AND OUTREACH SYMPOSIUM (E1)
Hands-on Space Education and Outreach (8)

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UTILIZING LIBS SYSTEM TO DETERMINE MACROSCOPIC PHYSICAL PROPERTIES OF IN SITU MARTIAN SAMPLES AND UNSUPERVISED MACHINE LEARNING TO COMMUNICATE RESULTS TO NON-SCIENTIFIC COMMUNITY

Abstract

Outreach to the public is important to scientific research, and machine learning can help bridge the gap between the scientist and the layman. We combine Laser-induced Breakdown Spectroscopy (LIBS) data from the ChemCam instrument, convolution neural networks (CNN) and unsupervised machine learning to garner useful scientific information from the Mars Curiosity mission, and propose a method of presenting it to the public. By studying the evolution of the characteristics of the LIBS emission lines over a series of shots at rasters on samples chosen to have a variety of macroscopic characteristics within the Mars simulants from NASA Jet Propulsion Laboratory (JPL) and in situ Mars samples from Curiosity, and combining this with CNN pattern recognition of the images of the ablation crater and the samples, we will contribute scientifically to the fundamental understanding of the behavior of laser-induced plasmas in confined spaces, but how do we make this accessible to the nonscientist? The terms, 'in hand sample' and 'hefting' are often used as the first description of a geological sample in studies of their properties. By applying unsupervised clustering to data from JPL simulants and in situ Mars samples we provide an interactive experience where the aspiring scientist or curious layman can 'heft' rocks that have similar characteristics to that of its cluster neighbors on Mars. While this work may not lead to an Archimedes 'EUREKA' moment (reportedly shouted while running down the street naked after having 'discovered' density), it will add to the fundamental understanding of LIBS and hopefully contribute to opening the world of science to someone who otherwise might have turned away. To the best of our knowledge, this type of analysis and clustering has never been attempted on in situ Martian samples or any other LIBS studies, and we utilize Python and sklearn packages to develop required algorithms and programs. No member of our team has previously presented this study.